Estimation of Density of 1, 4-dioxane Aqueous Solution and Liquid Structure of Water in Solution

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Abstract

The complicated concentration dependency of various physical properties of 1, 4-dioxane aqueous solution such as density and viscosity is likely to be due to changes of liquid structure of the water in the solution due to changes in solute concentrations.

In this study, the mole fraction (Xc) and temperature dependency of the density of 1, 4-dioxane aqueous solution have been determined under atmospheric pressure to formulate a method for estimating these physical properties of the solution that are affected by mole fraction in a complicated manner.

The conclusions are as follows.

1) The density of an aqueous solution at arbitrary mole fraction and temperature can be estimated from the mean mole fraction dependency of volumetric shrinkage rate using a standard aqueous solution of a simple mixed model.
2) Density of water in an aqueous solution at arbitrary mole fraction and temperature can be estimated from the mean mole fraction dependency of non-dimensional density.
3) Changes of the liquid structure of water and the density in aqueous solutions have been identified.
4) The temperature dependency of the density of an aqueous solution in a temperature range between 313 and 333 K has been identified.

Key words: 1, 4-dioxane Aqueous Solution, Density, Mole Fraction Dependency, Temperature Dependency, Liquid Structure of Water

Introduction

We[1)2)] showed that addition of the proper quantity of 1, 4-dioxane to LiBr aqueous solution is effective in enhancing the solubility of LiBr in relation to water, which is necessary for the realization of smaller-sized, higher performance absorption freezers that use LiBr aqueous solution and water as working media. To make use of this result in the design of absorption freezers, it is necessary to know values for the various physical properties of 1, 4-dioxane aqueous solution such as density, viscosity and evaporation latent heat. However, 1, 4-dioxane aqueous solution has a mixture mole fraction, for which water is standard, of $X_C=0.625$ as its azeotropic composition, and at $X_C=0.625$–0.825 has the unique evaporation property that even

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